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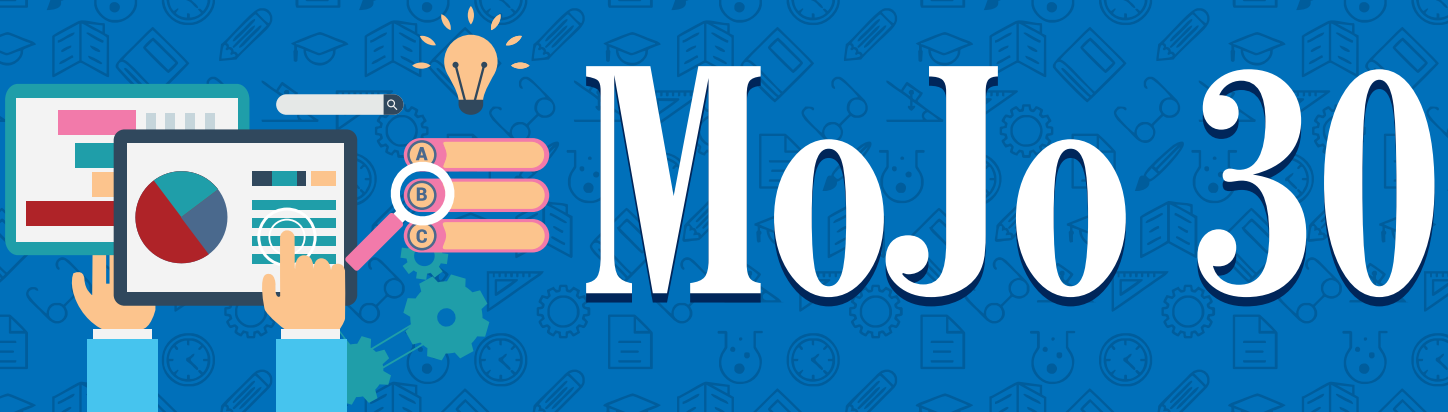
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# ONE-STEP LASER-BASED FABRICATION OF SELF-CLEANING METALLIC SURFACES CAN HELP PREVENT RUSTING

Relevant for: Science & Technology | Topic: Indigenization of technology and developing new technology

Ecofriendly self-cleaning surfaces that can protect biomedical and other applications from rusting and bacterial growth may soon be a reality with an ultrafast laser-based process that scientists have developed for fabrication of surfaces without use of coatings or additional surface treatment.

Scientists from International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI), an autonomous institute of the Department of Science and Technology (DST), Govt. of India, at its Centre for Laser Processing of Materials, have brought out a single-step method to develop super-hydrophobic functional surfaces that have ability to repel water. Such surfaces do not allow water to cling long enough to evaporate and leave behind residue.

This indigenous laser processing, which has been published in the journal '**Materials Performance and Characterization**', allows the fabrication of fast and flexible super-hydrophobic surfaces on a wide range of materials. By adjusting the laser processing parameters, in this method, it is possible to accurately control the structure pattern and precisely tailor the contact angle and the wetting properties of a variety of substrates. It is a robust, simple, fast, precise, and eco-friendly process and can be used to effectively fabricate robust super-hydrophobic surfaces and has high potential for large-scale application.

Currently, super-hydrophobic properties are achieved by developing rough surfaces and low surface free energy chemical coatings which are mostly two-step processes. The first step is to construct a rough surface by physical or chemical methods, and the second step involves chemical coatings of low surface free energy chemicals. However, these super-hydrophobic coating surfaces have many limitations, such as the use of fluorinated toxic reagent and poor mechanical stability.

In contrast, the single-step process developed by ARCI scientists comprises surface modification using a femtosecond laser (lasers emitting light pulses with durations between a few *femtoseconds* and hundreds of *femtoseconds*, i.e.  $10^{-15}$  of a second), non-thermal, and ecofriendly. The efficient and straightforward strategy will encourage the scalability of the process both in terms of reducing the cycle time and applying the developed hierarchical micro-scale and nano-scale structures over large areas for practical applications in the prevention of corrosion, bacterial growth, and avoidance of repeated cleaning.

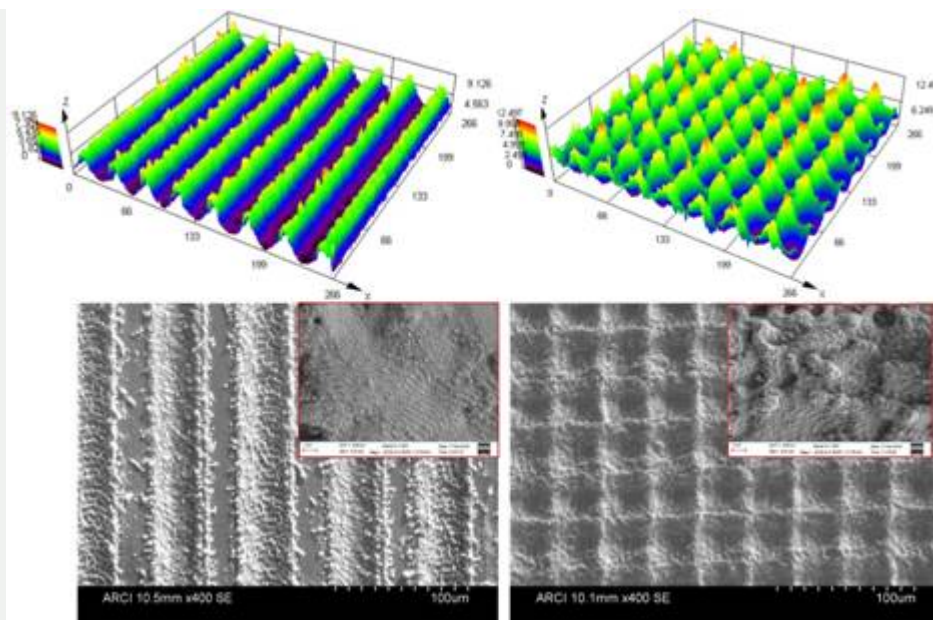
## [Patent:

**Ravi Bathe, K. S. Srin, and G. Padmanabham, "Method for Preparing Multifunctional and Isotropic, Uni-directional Superhydrophobic Surfaces using Ultrafast Laser" Indian Patent filed (24512/2020-DEL; dated 27/05/2020)**

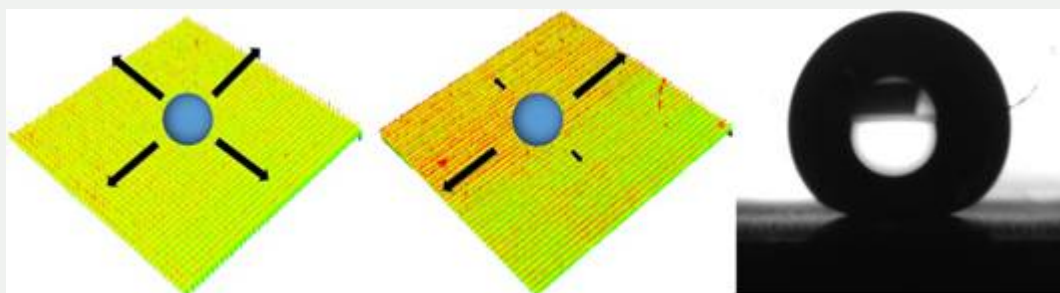
## Publication link:

<https://doi.org/10.1520/MPC20180090>

**For more details contact Dr. Ravi N Bathe ([ravi@arci.res.in](mailto:ravi@arci.res.in))**



**Figure 1: 3D Optical and SEM images of laser surface modified stainless steel surfaces showing microgrooves and microspikes with periodic nanostructure over it.**



**Figure 2: The schematic diagram shows the directional superhydrophobicity on different surface features. Profile of water droplet on laser modified stainless steel surface (contact angle ~ 170 degree).**

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### **NB/KGS(DST Media Cell)**

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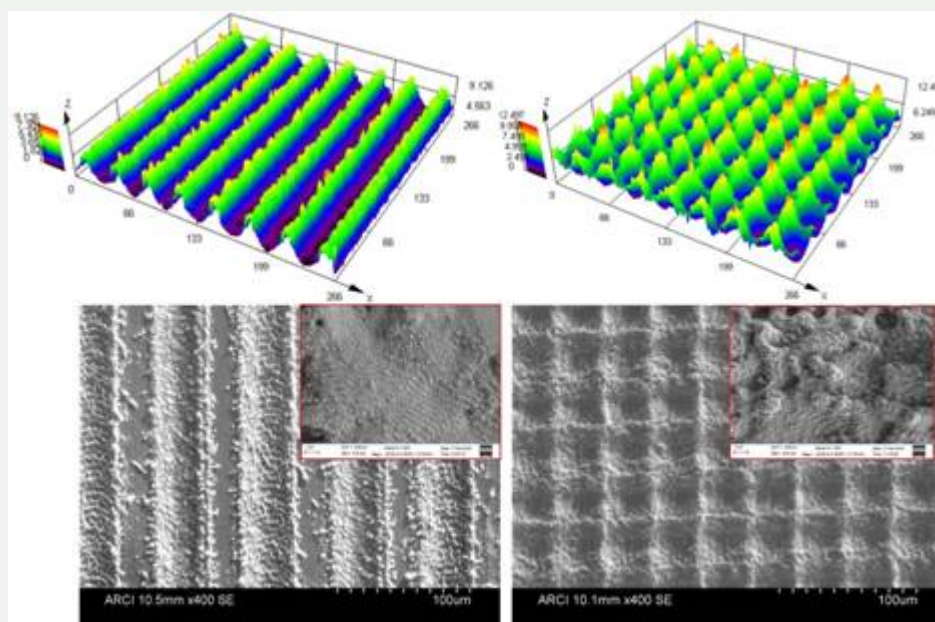
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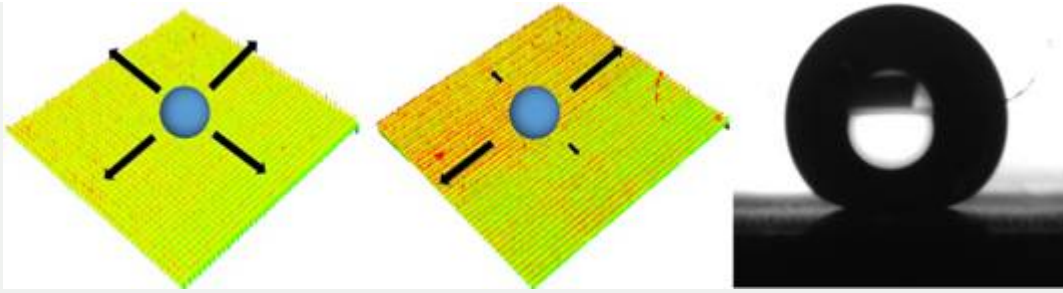


Figure 2: The schematic diagram shows the directional superhydrophobicity on different surface features. Profile of water droplet on laser modified stainless steel surface (contact angle ~ 170 degree).

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# SCIENCE BEHIND AIR-BREATHING SCRAMJET ENGINE

Relevant for: Science & Technology | Topic: Space Technology & related matters

Major feat: The cruise vehicle was flown at a hypersonic speed of Mach six for 20 seconds. | Photo Credit: [PTI](#)

The Defence Research and Development Organisation (DRDO) performed a major technological feat on September 7 when it flew a cruise vehicle at a hypersonic speed of Mach six for 20 seconds. The DRDO called the cruise vehicle Hypersonic Technology Demonstrator Vehicle (HSTDV). The centrepiece of the HSTDV was the indigenously developed air-breathing scramjet engine, which formed the HSTDV's propulsion system. If the mission's aim was to prove this air-breathing scramjet engine in flight, it was achieved.

The critical technologies developed for the HSTDV mission were the scramjet engine and its ignition, sustaining the ignition, ethylene fuel, generation of maximum energy from the engine, development of materials to take care of the high temperatures that occurred due to air friction on the leading edges of the cruiser's wings, tail surface and nose tip, and controlling the HSTDV with minimum drag and maximum thrust.

In an air-breathing scramjet engine, air from the atmosphere is rammed into the engine's combustion chamber at a supersonic speed of more than Mach two. In the chamber, the air mixes with the fuel to ignite a supersonic combustion but the cruiser's flight will be at a hypersonic speed of Mach six to seven. So it is called supersonic combustion ramjet or Scramjet.

On the D-day, a launch vehicle, which was derived from Agni 1 missile, rose from its launch pad in Odisha, carrying the HSTDV. The Agni 1 booster climbed to a height of 30 km in 12 seconds at a speed of Mach 5.6. The launch vehicle's control systems were made rugged enough to take care of its ascent through the atmosphere when it would experience heavy loads. When the launch vehicle reached an altitude of 30 km, the air intake ducts in the scramjet engine opened just before the launch vehicle separated smoothly from the HSTDV. At 30 km altitude, the cruise vehicle's nose cone split in two and fell off. Besides, the heat shield covering the cruiser was jettisoned. All these events took place in micro seconds as planned.

Air from the atmosphere was then rammed into the scramjet engine's combustion chamber at a supersonic speed. The air mixed with the atomised fuel, the fuel was ignited and the scramjet engine revved into action. The HSTDV flew for the next 20 seconds at a hypersonic speed of Mach six and fell 40 km away in the Bay of Bengal. The mission was a success.

Dr. Avinash Chander, former Director General, DRDO, said: "The fuel should be ignited in milliseconds. Not many countries were able to do it at the first instance... Energy generation should be maximum and drag should be minimum." The ignition should be sustained for the duration set for the flight. The entire HSTDV should be controlled but with maximum thrust.

Dr. R.K. Sharma, former Project Director, HSTDV, said lighting the fuel with the air coming in from the atmosphere at a supersonic speed was akin "to lighting a match-stick in a hurricane". DRDO developed special materials to take care of the cruise vehicle's nose-tip, tail and the wings' leading edges which were impacted by very high temperatures due to air friction. Higher the vehicle's velocity, much higher the temperature.

Dr. G. Satheesh Reddy, DRDO Chairman, said India mastering the scramjet engine technology

“will pave the way for developing many more critical technologies, materials and particularly hypersonic vehicles”.

The DRDO's missile complex in Hyderabad, comprising the Defence Research and Development Laboratory (DRDL), the Research Centre, Imarat (RCI), and the Advanced Systems' Laboratory (ASL) developed all the technologies needed for the mission.

Mastering the air-breathing scramjet technology will lead to the development of hypersonic missiles, faster civilian air transportation and facilities for putting satellites into orbit at a low cost.

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# INDIA'S FIRST COAST GUARD ACADEMY TO COME UP AT MANGALURU

Relevant for: Science & Technology | Topic: Defence related developments

**BENGALURU** : India's first Coast Guard academy will be established at Mangaluru, Defence Spokesperson (PRO) Bengaluru said on Saturday.

Around 158 acres Karnataka Industrial Area Development Board (KIADB) land has been taken over for setting up ICG Academy.

"India's first Coast Guard academy to come up at Mangaluru. 158 acres KIADB land taken over for setting up #ICGAcademy. A milestone towards professional maritime training to ICG officers & men & stakeholders," said Defence Spokesperson (PRO) Bengaluru in a tweet. (ANI)

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# THE NATIONAL FORENSIC SCIENCES UNIVERSITY BILL, 2020

Relevant for: Science & Technology | Topic: Biotechnology, Genetics & Health related developments

- The National Forensic Sciences University Bill, 2020 was introduced in Lok Sabha by the Minister of Home Affairs, Mr. Amit Shah on March 23, 2020. The Bill seeks to establish the National Forensic Sciences University. Key features of the Bill include:
- **Establishment of the University:** The Bill establishes the Gujarat Forensic Sciences University, Gandhinagar (established under the Gujarat Forensic Sciences University Act, 2008) and the Lok Nayak Jayaprakash Narayan National Institute of Criminology and Forensic Sciences, New Delhi, as a University called the National Forensic Sciences University at Gujarat. The Bill declares the University to be an institution of national importance. The Bill also repeals the 2008 Act. The campuses of the University will include the campuses of the two universities.
- **Objectives and functions of the University:** The objectives of the University include: (i) promoting academic learning in the field of forensic science in conjunction with applied behavioural science studies, law and other allied areas to strengthen the criminal justice institutions in India, (ii) fostering research and applied applications in forensic science, applied behavioural science studies, and law, (iii) coordinating with the central and state governments to improve investigations, crime detection and prevention through research, and (iv) assisting the central government in creating and maintaining a national forensic database for criminal investigation, including DNA and fingerprints.
- Functions of the University include: (i) providing training and research on forensic science, applied behavioural science, law, and criminology, (ii) establishing and maintaining colleges, schools, and research laboratories, and (iii) prescribing courses, holding exams, and granting degrees and other distinctions.
- **Authorities:** The Bill provides for several authorities under the University. These include: (i) the Chancellor of the University, who will head the University, (ii) the Court, which will review the broad policies and programmes of the University, (iii) the Board of Governors, which will be the principal executive body, and (iv) the Academic Council, which will specify the academic policies of the University.
- **Board of Governors:** The Board of Governors will be responsible for all administrative affairs of the University. The members include: (i) the Vice-Chancellor (appointed by the central government), (ii) the Financial Adviser, Ministry of Home Affairs, *ex officio* and (iii) five persons of eminence from fields such as forensic science and criminology. Nominated members will hold office for three years.
- Key functions of the Board include: (i) making policy decisions related to the working of the University, (ii) instituting courses of study in the University, and (iii) making, modifying or cancelling statutes which will specify the establishment, composition, and powers of various

authorities of the University. The first statutes of the University will require the approval of the central government.

- **Fund:** The University will maintain a Fund which will be applied towards its expenses. The following amounts will be credited to the Fund: (i) contributions by the central or state government, (ii) grants, gifts, and donations, (iii) income from fees, and (iv) amounts received from any other source. These amounts will be invested based on the recommendations of the Finance Committee.
- **Appeals:** Any student or candidate whose name has been removed from the rolls of the University and who has been barred from appearing for examinations for more than one year may appeal to the Board of Governors for review of the decision. Any dispute arising out of the disciplinary action taken by the University against a student may be referred to a Tribunal of Arbitration (at the request of the student). Disputes arising out of the contract between an employee and the University may also be referred to a Tribunal of Arbitration.

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# THE RASHTRIYA RAKSHA UNIVERSITY BILL, 2020

Relevant for: Science & Technology | Topic: Defence related developments

- The Rashtriya Raksha University Bill, 2020 was introduced in Lok Sabha by the Minister of Home Affairs, Mr. Amit Shah on March 23, 2020. The Bill seeks to provide for the establishment of the Rashtriya Raksha University. Key features of the Bill include:
- **Establishment of the University:** The Bill establishes the Raksha Shakti University, Gujarat (established under the Raksha Shakti University Act, 2009) as a University called the Rashtriya Raksha University in Gujarat. The Bill declares the University to be an institution of national importance. The Bill also repeals the 2009 Act.
- **Authorities:** The Bill provides for several authorities under the University. These include: (i) the Governing Body, to frame the broad policies and programmes of the University, (ii) the Executive Council, which will be the principal executive body, and (iii) the Academic Council, which will specify the academic policies of the University.
- **Objectives:** The key objectives of the University include: (i) providing dynamic and high standards of learning and research, (ii) providing a working environment dedicated to advancing research, education and training in the domain of policing, and (iii) promoting and providing public safety.
- **Functions:** The functions of the University include: (i) providing instructions and research in police sciences, including coastal policing and cyber security, (ii) establishing and maintaining colleges, and (iii) prescribing courses, holding exams, and granting degrees and other distinctions.
- **Governing Body:** The Governing Body will be responsible for all administrative affairs of the University. It will consist of up to 15 members. The members will include: (i) the Vice-Chancellor (appointed by the central government), (ii) one representative of Ministry of Home Affairs nominated by the central government, not below the rank Joint Secretary, (iii) one representative of State Police Universities by rotation, and (iii) three persons having expertise in defence, policing, internal security and allied fields. Nominated members will hold office for three years.
- **Key functions of the Governing Body include:** (i) formulating policies and programmes of the University, (ii) advising on matters relating to the duration of courses, conferment of degrees, and admission standards, and (iii) specifying policies relating to the administration and working of the University and taking related decisions, and (iv) making statutes which will specify the establishment, composition, and powers of various authorities of the University, as well as the manner of recognition of an institution by the Executive Council as an affiliated college. The first statutes of the University will require the approval of the central government.
- **Fund:** The University will maintain a Fund which will be applied towards its expenses. The following amounts will be credited to the Fund: (i) contributions by the

central government or state governments, (ii) grants, gifts, and donations, (iii) income from fees, and (iv) amounts received from any other source. These amounts will be invested based on the approval of the central government.

- **Dispute and appeals:** Any student or candidate whose name has been removed from the rolls of the University and who has been barred from appearing for examinations for more than one year may appeal to the Governing Body for review of the decision. Any dispute arising out of the disciplinary action taken by the University against a student may be referred to a Tribunal of Arbitration (at the request of the student). Disputes arising out of the contract between an employee and the University may also be referred to a Tribunal of Arbitration.

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# SUCCESSFUL FLIGHT TEST OF ABHYAS

Relevant for: Science & Technology | Topic: Defence related developments

Successful flight test of ABHYAS - High-speed Expendable Aerial Target (HEAT) was today conducted by Defence Research and Development Organisation (DRDO) from the Interim Test Range, Balasore in Odisha. During the trials, two demonstrator vehicles were successfully test flown. The vehicle can be used as target for evaluation of various missile systems.

Abhyas is designed & developed by Aeronautical Development Establishment (ADE), DRDO. The air vehicle is launched using twin underslung booster. It is powered by a small gas turbine engine and has MEMS based Inertial Navigation System (INS) for navigation along with the Flight Control Computer (FCC) for guidance and control. The vehicle is programmed for fully autonomous flight. The check out of air vehicle is done using laptop based Ground Control Station (GCS).

During the test campaign, the user requirement of 5 km flying altitude, vehicle speed of 0.5 mach, endurance of 30 minutes and 2g turn capability of the test vehicle were successfully achieved.

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## ABB/Nampi/Rajib

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# INDIAN SPACE PROMOTION AND AUTHORISATION CENTRE (IN-SPACE) TO PROMOTE PRIVATE INVESTMENT AND INNOVATION IN THE SPACE SECTOR: DR JITENDRA SINGH

Relevant for: Science & Technology | Topic: Space Technology & related matters

The Union Minister of State (Independent Charge), Development of North Eastern Region (DoNER), MoS PMO, Personnel, Public Grievances, Pensions, Atomic Energy and Space, Dr Jitendra Singh said in a written reply to Rajya Sabha that the Government has launched the Indian Space Promotion and Authorisation Centre (IN-SPACE) to promote private investment and innovation in the space sector.

IN-SPACE will facilitate and support the Private Sector in the following ways:

IN-SPACE is the Institutional and Regulatory mechanism established by Government to facilitate greater private participation. Financial provisions are not covered under this mechanism.

Private players can participate in:

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## INDIA SUCCESSFULLY TEST FIRES LASER-GUIDED ANTI-TANK MISSILE AMID CHINA BORDER TENSION

Relevant for: Science & Technology | Topic: Defence related developments

The weapon, having a range of up to four km, was test fired from an MBT Arjun Tank at KK Ranges in Armoured Corps Centre and School (ACC&S) in Ahmednagar on Tuesday

**NEW DELHI** : An indigenously developed laser-guided anti-tank missile has been successfully test fired by the DRDO at a firing range in Maharashtra's Ahmednagar, officials said on Wednesday.

The weapon, having a range of up to four km, was test fired from an MBT Arjun Tank at KK Ranges in Armoured Corps Centre and School (ACC&S) in Ahmednagar on Tuesday, they said.

The laser-guided anti-tank guided missile (ATGM) is likely to significantly enhance the fire-power capability of the Indian Army particularly along the frontiers with Pakistan and China, the officials said.

Defence Minister Rajnath Singh congratulated the Defence Research and Development Organisation (DRDO) on successful test firing of the ATGM.

Congratulations to [@DRDO India](#) for successfully conducting test firing of Laser Guided Anti Tank Guided Missile from MBT Arjun at KK Ranges (ACC&S) in Ahmednagar.

India is proud of Team DRDO which is assiduously working towards reducing import dependency in the near future. [pic.twitter.com/WuBivV7VYU](https://pic.twitter.com/WuBivV7VYU)

The officials said the ATGM hit the targets with total accuracy and precision.

"The missile employs a tandem heat warhead to defeat explosive reactive armour protected armoured vehicles. It has been developed with multiple-platform launch capability and is currently undergoing technical evaluation trials from gun of MBT Arjun," said an official.

The Arjun is a third generation main battle tank developed by the DRDO.

Pune-based Armament Research and Development Establishment (ARDE) developed the ATGM in association with High Energy Materials Research Laboratory and Instruments Research and Development Establishment (IRDE).

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